Effect of Replacing tallow with Rice Bran and Olive oils on the Quality Properties restructured beef patties

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Abstract— **The effects of replacing tallow with rice bran oil and olive oil at a 20%, 40% or 60% on the quality and stability of restructured beef patties were investigated. While the highest pH values were found after 3 days in the control, the lower cooking loss increased storage days. Lightness was decreased during storage time. TBARS during days of the storage period and then increased the end of the storage period. Replacement tallow with 20% olive oil beef patty showed lower values for TBARS when compared with the other samples until 3 days. Saturated fatty acid (SFA) content of beef patties decreased as the level of plant oils increased, but unsaturated fatty acid (UFA) content was increased. Monoun-saturated fatty acid (MUFA) was higher in olive oil and polyunsaturated fatty acid (PUFA) was higher in rice bran oil. Replacing tallow with rice bran oil and olive oil beef patties were increased UFA and were similar physical characteristics of all beef patties.**

Keywords— **Restructured beef patties, Rice bran oil, Olive oil**.

I. INTRODUCTION

Fat in meat products plays a major role in forming stable emulsions, reducing cooking loss, improving water holding capacity and binding properties, forming rheological and structural properties and providing juiciness and hardness to the products [1, 2]. However, diets high animal fat content has been related to the increased incidence of obesity, hypertension, cardiovascular diseases, and coronary heart diseases. The quality characteristics and nutritional value of ground beef products can be increased by substituting animal fat with vegetable oils, which are free of cholesterol and have a higher ratio of unsaturated to saturated fatty acids [3, 4]. As a result, novel approaches have been considered for altering the fatty acid profile of red meat products to reduce SFAs and increase UFAs. Olive oil is rich in MUFAs than typical vegetable oils. Rice bran oil is an excellent source of PUFA, which are helpful in lowering cardiovascular risks. Rice bran oil lowered human blood cholesterol more effectively than did sunflower, corn and safflower oils [5].

The objective of this study was to investigate the effect of replacing tallow with rice bran oil and olive oil at a 20%, 40% or 60% of restructured beef patties on the pH, cooking loss, lightness, TBARS, and fatty acid properties and replacing tallow with rice bran oil and olive oil restructured beef patties contain different ratios of UFAs while maintaining quality when compared with control beef patties.

II. MATERIALS AND METHODS

1. Materials and restructured beef patties process

Restructured beef patties were prepared from the muscles of top rounds obtained from a local retailer. Excess fat was trimmed from the meat and then ground in a grinder twice through a 7-mm plate. Ingredient composition of the patties is presented in Table 1 and mixed by hand for 10 min, weighed into 80 g portions, and shaped by hand at 1.5 x 10 cm at during 7 days of storage at 4°C.

2. Measurements

For pH determination, 3 g of sample were homogenized with 90 ml of distilled water. The pH value of the sample was determined using a pH meter (MP230, Mettler Toledo, Switzerland). Cooking loss (%) was recorded for each sample by weighing before

Table 1. Formulation of restructured beef patties with rice bran oil and olive oil. (Unit : %)

Ingredient	Treatment[1)]						
	C	TR1	TR2	TR3	TO1	TO2	TO3
Beef meat	75.5	75.5	75.5	75.5	75.5	75.5	75.5
Tallow	20	16	12	8	16	12	8
Rice bran oil		4	8	12			
Olive oil					4	8	12
Solt	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Water(ice)	3	3	3	3	3	3	3
Total	100						

[1)] C ; control(tallow 20%), TR1 ; replacement of tallow with 20% rice bran oil, TR2 ; replacement of tallow with 40% rice bran oil, TR3 ; replacement of tallow with 60% rice bran oil, TO1 ; replacement of tallow with 20% olive oil, TO2 ; replacement of tallow with 40% olive oil, TO3 ; replacement of tallow with 60% olive oil.

and after cooking. The lightness (CIE L*) were determined using Chromameter (CR-300. Minolta Co., Japan). TBARS of patties were determined by the spectrophoto-meter method [6]. Lipids were extracted using the method of Folch and others [7] and methylated as described by Slover and Lanza [8]. Methylated lipids were analyzed with a gas chromatograph (Agilent Technologies 6890N GC system, USA). The statistical analysis was performed by SAS program [9]. The data were subjected to analysis of variance (ANOVA) and Duncan's test to compare the sample means. The significance level was 0.05.

III. RESULTS AND DISCUSSION

The effect of rice bran oil and olive oil on pH, cooking loss and lightness of beef patties on storage days is shown in Table 2. The pH was higher in the control than replacement tallow with rice bran oil and olive oil of beef patties at after 3 days. The beef patties containing beef and pork fats had higher pH values compared to vegetable oils beef patties [10]. Cooking loss were decreased (p<0.05) with storage time. However, cooking loss was not significantly different between the control and the treatments at storage 7 days. The increase of pH due to cooking loss was decrease for all treatments at storage time. Lightness was decreased during storage time and TR1 highest on day 7 of storage.

The analysis of variance indicates that the TBARS were significantly affected by the rice bran oil and olive oil treatments (Fig. 1). The TBARS for all treatments increased (p<0.05) with storage time. Restructured beef roasts containing rice bran oil and fiber were the significant and beneficial suppressing cholesterol oxidation [11]. The TBARS for rice bran oil and olive oil samples were significantly lower than those for the control due to the fact that replacement tallow with rice bran oil and olive oil gave differences in fatty acid composition.

Table 3 shows the fatty acid composition of replacing tallow with rice bran oil and olive oil

Table 2. Changes of pH, cooking loss and L* replacing tallow with rice bran oil and olive oil restructured patties during storage time at 4° C.

	Storage (days)	Treatment[1)]						
		C	TR1	TR2	TR3	TO1	TO2	TO3
pH	0	5.63^{Bb}	5.61^{Cc}	5.56^{DEc}	5.65^{Bb}	5.68^{Ab}	5.54^{Eb}	5.56^{Db}
	3	5.89^{Aa}	5.74^{Bb}	5.73^{Bb}	5.70^{Ca}	5.74^{Bb}	5.74^{Ba}	5.69^{Ca}
	7	5.89^{Aa}	5.81^{Ba}	5.79^{Ba}	5.73^{CDa}	5.69^{Da}	5.74^{Ca}	5.72^{CDa}
Cooking loss	0	27.05^{ABa}	27.05^{ABa}	24.29^{BCa}	25.45^{BCa}	23.02^{Ca}	25.22^{BCa}	28.77^{Aa}
	3	17.15^{Cb}	15.92^{Cb}	21.91^{Bab}	21.62^{Bb}	17.62^{Cb}	17.69^{Cb}	28.77^{Aa}
	7	17.89^{ABb}	17.08^{Bb}	19.68^{ABb}	18.79^{ABb}	17.71^{ABb}	17.16^{Bb}	20.69^{Ab}
L* (lightness)	0	47.63^{Ba}	48.22^{Ba}	48.92^{ABa}	44.38^{C}	48.27^{Ba}	51.04^{Aa}	47.59^{B}
	3	45.72^{BCb}	45.11^{CDb}	47.34^{Aab}	44.54^{CD}	44.20^{Db}	45.32^{BCDb}	46.46^{AB}
	7	45.16^{Bb}	47.44^{Aa}	45.36^{Bb}	43.98^{B}	43.59^{Bb}	44.03^{Bb}	44.97^{B}

[1)] C ; control(tallow 20%), TR1 ; replacement of tallow with 20% rice bran oil, TR2 ; replacement of tallow with 40% rice bran oil, TR3 ; replacement of tallow with 60% rice bran oil, TO1 ; replacement of tallow with 20% olive oil, TO2 ; replacement of tallow with 40% olive oil, TO3 ; replacement of tallow with 60% olive oil.

[A,B,C,D] Means within a row with different superscript letters are significantly different at $P < 0.05$.

[a,b,c] Means within a column with different superscript letters are significantly different at $P < 0.05$.

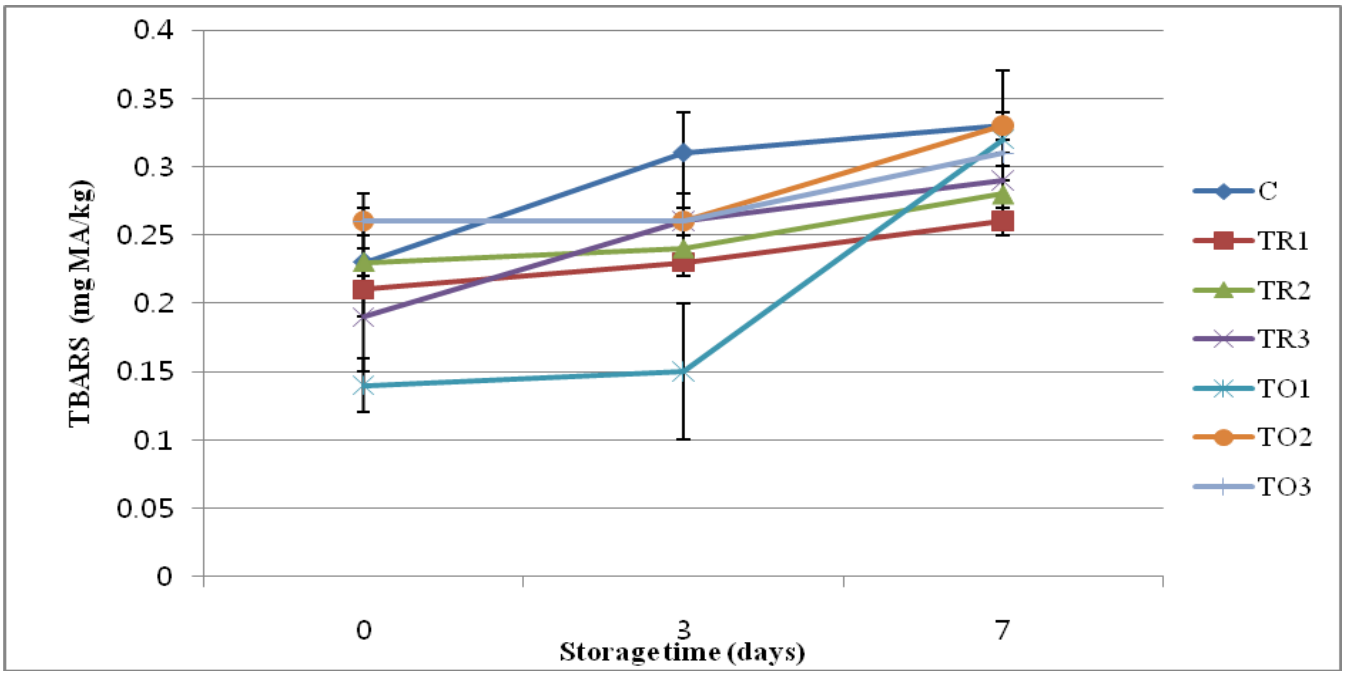

Fig. 1. Changes of TBARS replacing tallow with rice bran oil and olive oil restructured patties during storage time at 4℃.
C ; control(tallow 20%), TR1 ; replacement of tallow with 20% rice bran oil, TR2 ; replacement of tallow with 40% rice bran oil, TR3 ; replacement of tallow with 60% rice bran oil, TO1 ; replacement of tallow with 20% olive oil, TO2 ; replacement of tallow with 40% olive oil, TO3 ; replacement of tallow with 60% olive oil.

restructured beef patties. In all the treatments, palmitic acid (C 16:0) and oleic acid (C 18:1) were more plentiful than other fatty acids. Calculated fatty acid compositions show that substitution of tallow with rice bran oil and olive oil reduced percentage of SFA from 33.64% in the control to 27.22-33.86% in the replacing with rice bran oil and olive oil beef patties. The total amount of MUFA ranged from 51.77% to 66.78%, and those replacing tallow with 60% olive oil (TO3) had highest total MUFA. The highest PUFA level was in the replacing tallow with 60% rice bran oil (TR3).

Table 3. Comparison of fatty acid composition (%) of replacing tallow with rice bran oil and olive oil restructured beef patties.

Fatty acid(%)		Treatments [1)]						
		C	TR1	TR2	TR3	TO1	TO2	TO3
Capric acid	($C_{10:0}$)	0.03^{A}	0.03^{B}	0.02^{C}	0.02^{D}	0.03^{B}	0.02^{C}	0.02^{E}
Lauric acid	($C_{12:0}$)	0.11^{A}	0.10^{B}	0.07^{C}	0.06^{D}	0.09^{B}	0.07^{C}	0.05^{E}
Myristic acid	($C_{14:0}$)	2.95^{A}	2.41^{B}	1.94^{C}	1.56^{D}	2.37^{B}	1.96^{C}	1.58^{D}
Palmitic acid	($C_{16:0}$)	23.41^{A}	21.96^{B}	21.21^{C}	20.57^{D}	21.25^{C}	19.50^{E}	18.28^{F}
Palmitoleic acid	($C_{16:1}$)	5.74^{A}	4.77^{B}	3.51^{D}	2.57^{E}	4.20^{C}	3.45^{D}	2.87^{E}
Margaric acid	($C_{17:0}$)	0.62^{A}	0.50^{C}	0.41^{D}	0.37^{E}	0.57^{B}	0.43^{D}	0.34^{F}
Magaoleic acid	($C_{17:1}$)	0.91	0.75	0.56	2.32	0.73	0.56	0.43
Stearic acid	($C_{18:0}$)	9.45^{A}	8.42^{A}	7.58^{A}	4.30^{B}	9.42^{A}	8.84^{A}	8.48^{A}
Oleic acid	($C_{18:1}$)	52.73^{D}	51.58^{E}	49.49^{F}	46.28^{G}	56.66^{C}	60.64^{B}	63.10^{A}
Linoleic acid	($C_{18:2}$)	2.69^{E}	8.16^{C}	13.89^{B}	20.10^{A}	3.44^{D}	3.43^{D}	3.75^{D}
Linolenic acid	($C_{18:3}$)	0.52^{B}	0.42^{C}	0.33^{DE}	0.72^{A}	0.41^{C}	0.32^{E}	0.35^{D}
Gadoneic acid	($C_{20:0}$)	0.07^{E}	0.15^{D}	0.24^{B}	0.33^{A}	0.15^{D}	0.19^{C}	0.24^{B}

Gondoic acid	($C_{20:1}$)	0.56^{C}	0.58^{B}	0.59^{B}	0.61^{A}	0.49^{D}	0.44^{E}	0.38^{F}
Arachidonic acid	($C_{20:4}$)	0.22^{A}	0.17^{B}	0.16^{BC}	0.17^{B}	0.20^{A}	0.14^{C}	0.13^{C}
SFA		36.64^{A}	33.58^{BC}	31.47^{CD}	27.22^{F}	33.86^{B}	31.02^{DE}	28.99^{EF}
UFA		63.36^{F}	66.42^{DE}	68.53^{CD}	72.78^{A}	66.14^{E}	68.98^{BC}	71.01^{AB}
MUFA		59.94^{BC}	57.67^{C}	54.15^{D}	51.77^{D}	62.08^{B}	65.10^{A}	66.78^{A}
PUFA		3.42^{E}	8.75^{C}	14.38^{B}	21.01^{A}	4.05^{DE}	3.88^{DE}	4.24^{D}

[1)] C ; control(tallow 20%), TR1 ; replacement of tallow with 20% rice bran oil, TR2 ; replacement of tallow with 40% rice bran oil, TR3 ; replacement of tallow with 60% rice bran oil, TO1 ; replacement of tallow with 20% olive oil, TO2 ; replacement of tallow with 40% olive oil, TO3 ; replacement of tallow with 60% olive oil.

[A,B,C,D] Means within a row with different superscript letters are significantly different at $P < 0.05$.

I. CONCLUSIONS

Commercially available rice bran oil and olive oil were used as substitutes for tallow in the production of restructured beef patties. Replacement tallow with rice bran oil and olive oil affected decreased pH of restructured beef patties. Rice bran oil were decreased the TBARS ($P<0.05$). Calculated fatty acid compositions replacement tallow with rice bran oil of beef patties were successful in raising the PUMA and replacement tallow with olive oil of beef patties were successful in raising the MUMA. Thus, replacing tallow with olive oil and rice bran oil restructured beef patties were nutritional value and health benefits of beef patties with minimal changes in composition and fatty acids.

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